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COMPLETE SPECIFICATION

Improvements in or relating to self-locking retaining rings

We, WALDES KOH-I-NOOR INC., a corporation organized and existing under the laws of the State of New York, United States of America, of 47-16, Austel Place, Long Island City 1, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to self-locking retaining rings of the type comprising a closed ring body or rim and inclined resilient prongs extending radially from an edge thereof (the inner edge for the external ring and the outer edge for the internal ring), the free ends of which are adapted to bite into the surface of the ring carrier in manner as to lock the ring thereto against movement in the direction toward which the prongs incline.

Conventional self-locking rings of this general type have recently grown in popularity because they offer a simple and effective means of securing machine parts on shafts or in housings without grooves in those assemblies where only moderate thrust loads are expected. However, two main disadvantages of such rings legislate against their wider use, one being that because of low holding power they are limited to assemblies wherein the ring is subject to moderate thrusts only as aforesaid. The other resides in the permissible small angle of inclination of the resilient prongs to the plane of the ring body, which often causes error in the assembly of the rings, the persons mounting them being unable, because of the smallness of said angle, to discriminate between the correct and incorrect assembly position of the rings and proceeding to mount them on their carriers with the prongs sloping in the wrong direction, which destroys their effectiveness.

In connection with the low holding power of self-locking rings of the type under consideration, it should be explained that the holding power of such a ring in its assembly against thrusts exerted by the machine part located thereby depends on several factors which are independent of one another. One such factor is the sheer strength of the material of the ring carrier, assuming, of course, that this material is not so hard as to make the locking prongs wholly ineffective. Another factor is the strength of the closed rim or body of the ring on which depends its resistance to distortion under the forces transmitted to it by the prongs and being effective in the direction of the latter. A third factor is the resistance of the resilient prongs to buckling under load. From the above it will be seen that when the sheer strength of the ring carrier is such that the prongs can effectively bite into and lock with the carrier, the maximum resistance of the ring to axial thrust, i.e. its holding power, depends on the stiffness or rigidity of the rim or body portion on the one hand, and on the ability of the resilient prongs to resist buckling on the other hand.

Assuming that the angle of inclination of the prongs to the plane of the rim or body portion of such rings could be increased to a degree that would enable persons assembling same more readily to perceive the direction of prong inclination, without at the same time sacrificing the capability of the ends of the prong to lock to the surface of the ring carrier, such could also result in a substantial increase in the tolerances of such rings. That is to say, a self-locking ring of the character under consideration, whose prongs have, for example a 15° angle of inclination to the plane of the ring body or rim, is capable of taking up greater diameter variations in the ring carrier than is a similar type self-locking ring but whose locking prongs are

inclined to the plane of the ring body by the conventionally lesser angle.

It is an object of this invention to overcome the above-noted disadvantages of conventional self-locking retaining rings of the stated character resulting from the low holding power of such rings and the small angle of inclination of their locking prongs to the plane of the ring body.

The invention consists in a self-locking retaining ring of spring material for securing a machine part against axial displacement relative to a carrying member mounting said part, comprising a closed circular ring body and circumferentially spaced resilient locking prongs extending radially from an edge portion of the ring body, said ring body having substantially concavo-convex section whereby its inner and outer edge portions have approximately the form of oppositely disposed truncated cones, said prongs being inclined to the general plane containing the ring at an angle corresponding to the frusto-conical surface of the edge portion from which they extend.

To provide a substantial diametral tolerance of such rings and to render the prong direction clearly recognisable, the angle of inclination of the prongs and of the frusto-conical surface from which they extend, may be approximately 15°, such angle being measured with respect to the general plane of the ring, such plane being the plane of intersection of the two oppositely disposed truncated cones referred to hereinbefore.

To make the invention clearly understood, reference will now be made to the accompanying drawings, which are given by way of example and in which:—

Fig. 1 is a plan view of an external self-locking retaining ring according to the invention;

Fig. 2 is a section taken on line 2-2 of Fig. 1;

Fig. 3 is a part-section view of a retaining ring assembly employing a ring as shown in Fig. 1; and

Figs. 4, 5 and 6 are corresponding views illustrating the internal self-locking ring of the invention and its application.

As seen in Figs. 1-3, a self-locking ring of the so-called external form which is adapted to be applied to a carrier such as a shaft, spindle, or the like comprises a closed circular body portion or rim 10 provided at equally spaced intervals along its inner edge 11 with a plurality of resilient locking prongs which extend radially inward therefrom and are inclined by a small angle to the plane of said rim, eight such prongs 12*a*-12*h* being shown by way of example. As is well known, such a ring may be easily fabricated from spring metal in a simple stamping die which cuts the prongs to length such that their inner edges 13*a*-13*h*, which are disposed at a right angle to a diameter on the prong centre line, extend as tangents of a circle having slightly lesser diameter than that of the shaft or spindle for which the particular ring is designed.

Thus, consequent to the resiliency and slope of its prongs 12*a*-13*h*, a ring properly faced with respect to a carrier such as a shaft 14 (Fig. 3), i.e., with its prongs sloped away from the shaft, may be pushed over the end of the said shaft and thence shifted axially therealong until its body or rim 10 bears tight against an end face of a machine part 15 intended to be secured against axial displacement on the shaft. Assuming that the resilient prongs have the requisite stiffness to prevent them from buckling, their inner edges 13*a*-13*h* frictionally grip with and bite into the surface material of the shaft with a holding power which increases, up to a certain limit, with increase in the axial thrust imparted to the ring body by the machine part 15 in direction as to cause the prongs to tend to straighten or to move into the plane of said ring body.

As suggested above, the holding power of conventional self-locking rings of the type so far described is limited by the inability of the ring body or rim 10 to withstand, without some deformation, the heavy forces transmitted to it in radial direction by the prongs as they tend to straighten under load, and the conventional rings are also open to the objection that the angle which their prongs bear to the plans of the ring body is so small as to give rise to faulty assembly of ring to shaft resulting from the ring being improperly faced when pushed over the shaft. The aforesaid small angle of prongs to plane of ring body also results in the ring being unable with a very small range of shaft diameters, i.e., it has very limited shaft diameter tolerance.

According to the invention, the aforesaid objections to the conventional self-locking ring of the type under consideration are simply yet effectively overcome by providing the ring body or rim 10 with concavo-convex section radially, as results from shaping said body so that it has roughly V-section radially. Hence, the outer edge portion 10*a* of the ring body or rim has the form of a truncated cone and the inner edge portion 10*b* similarly has the form of a truncated cone but is coned oppositely to said outer edge portion, and by sloping or inclining the prongs 12*a*-12*h* so that they extend in continuation of the coned inner edge portion 10*b* of the ring body. Such gives two important advantages not present in the conventional self-locking ring. Firstly, due to the V-section of the ring body or rim 10, its stiffness and hence its resistance to radial outward deformation at the prongs is substantially increased. Secondly, the angle

of inclination of the prongs 12*a*-12*h* may be increased to approximately 15° without at the same time increasing the angle between the prongs and the inner edge portion of the ring body or rim 10, on which angle in part depends the resistance of the prongs to buckling under loads tending to straighten said prongs.

The beneficial effect of the increased stiffness of the ring body or rim according to the invention is found in the greater holding power of the ring as a whole, as compared to rings whose body portion or rim extend in a single continuous plane at a right angle to the shaft axis. This greater holding power is also achieved without any increase in the thickness of the material of the ring as would reduce the resiliency of the prongs, and without sacrifice of the inherently simple design of the ring or the ability to stamp such rings out in a simple die. The increased angle of the prongs to general plane of ring body or rim gives two principal advantages. Firstly, the tolerance of the ring is increased, as the greater the permissible initial slope of the prongs the greater the variation in shaft diameters that the ring will effectively take. Secondly, increased sloping or angularity of the prongs to ring body makes for simple and more accurate assembly because of the prong sloping and direction thereof being more readily perceivable as compared to conventional pronged rings.

The aforesaid improved properties of a self-locking external ring may be obtained also for the self-locking internal ring shown in Figs. 4-6. As well understood, the internal ring is adapted to be inserted in the bore of a housing 24, such as is illustrated in Fig. 6, and to lock with the bore wall thereof, thereby to secure a machine part 25 against axial displacement. Accordingly, such an internal ring comprises a ring body or rim 20 having external diameter substantially less than that of the bore, and being provided along its outer edge 21 with a plurality of inclined resilient prongs 22*a*-22*h* which extend radially outwardly and terminate in locking edges 23*a*-23*h* disposed on a circle of slightly larger diameter than that of the housing bore.

As with the ring body or rim of the external ring shown in Figs. 1-3, the ring body or rim 20 of the internal ring is fashioned to V-section radially, whereby its inner and outer edge portions have the form of truncated cones 20*a*, 20*b*, respectively, which are oppositely disposed, and whereby the prongs 22*a*-22*h* extend from the coned outer edge portion 20*b* and are inclined to the general plane of the ring by an angle corresponding to the coning angle of said outer edge portion. By this construction and arrangement, the rigidity of the ring body or rim, and hence its resistance to being deformed or buckled by loads applied thereto through the prongs in inward direction, is improved and the angle of the prongs to general plane of said ring body may be increased up to the maximum angle of slope of approximately 15°, with the advantages of increased ring tolerance and simpler and more foolproof assembly being gained therefrom.

By reference to Figs. 3 and 6 illustrating the improved external and internal rings of the invention assembled on a carrier and functioning to prevent axial displacement of a machine part mounted on the carrier, it will be observed that the rings are faced so that the apex line or circular ridge between their oppositely coned edge portions make contact with an end face of said machine part. This line engagement makes possible extremely close contact between ring and machine part and hence avoids objectionable end play. It will also be observed that both forms of ring have edge portions disposed remote from the prongs and spaced away from the machine part being secured, thus leaving space for entry of a ring gripping tool rearwardly of the ring body, thereby facilitating disassembly of the ring. Thus, in addition to simplifying ring assembly as aforesaid, a ring according to both forms of the invention also facilitates ring dismantling or disassembly.

What we claim is:—

1. A self-locking retaining ring of spring material for securing a machine part against axial displacement relative to a carrying member mounting said part, comprising a closed circular ring body and circumferentially spaced resilient locking prongs extending radially from an edge portion of the ring body, said ring body having substantially concavo-convex section, whereby its inner and outer edge portions have approximately the form of oppositely disposed truncated cones, said prongs being inclined to the general plane containing the ring at an angle corresponding to the frusto-conical surface of the edge portion from which they extend.

2. A self-locking ring as claimed in claim 1, wherein the prongs extend from the inner edge portion of the ring body.

3. A self-locking ring as claimed in claim 1, wherein the prongs extend from the outer edge portion of the ring body.

4. A self-locking retaining ring as claimed in claim 1, wherein the said circumferentially spaced resilient prongs extending radially from an edge of said ring body are inclined at an angle of approximately 15° to the general plane of the ring.

5. A self-locking retaining ring constructed substantially as hereinbefore described

with reference to, and as illustrated in, Figs. 1 to 3 of the accompanying drawings.

6. A self-locking retaining ring constructed substantially as hereinbefore described with reference to, and as illustrated in, Figs. 4 to 6 of the accompanying drawings.

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780,237 COMPLETE SPECIFICATION
1 SHEET
This drawing is a reproduction of the Original on a reduced scale.

FIG. 1

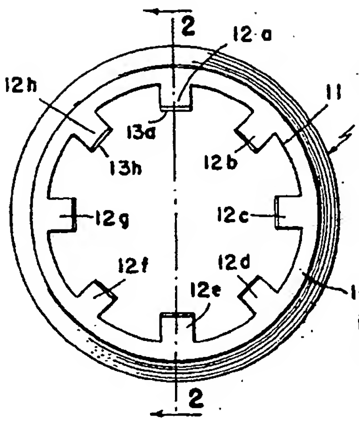

FIG. 2

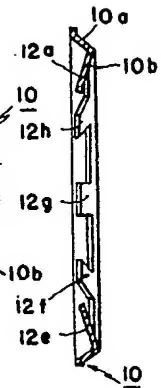

FIG. 3

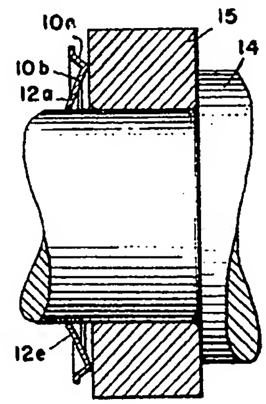

FIG. 4

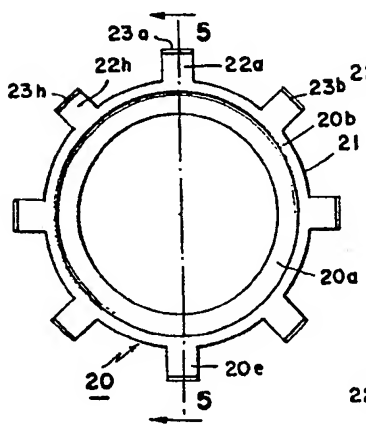

FIG. 5

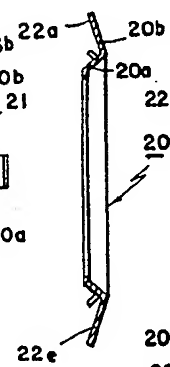

FIG. 6